DOCUMENT RESUME

ED 187 560 SE 030 948

TITLE Guide to Building Effective Pre-Engineering Programs.

INSTITUTION National Academy of Sciences - National Research Council, Washington, D.C. Assembly of Engineering.; National Academy of Sciences-National Research Council, Washington, D.C. Committee on Minorities in Engineering

PUB DATE Sep 79

NOTE 56p.; Not available in hard copy due to copyright restrictions.

AVAILABLE FROM Committee on Minorities in Engineering, Assembly of Engineering, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418 (no price quoted).

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.

DESCRIPTORS *Curriculum Development; *Engineering; *Engineering Education; Higher Education; *Minority Groups; Professional Associations; Program Descriptions; Program Development; Science Curriculum; *Science Education; Scientific Personnel; *Secondary Education

ABSTRACT

This guide is intended for use by individuals sensitive to the needs of minority students for precollege programs that will prepare them for college-level engineering course work and eventual entry into the engineering profession. The guide emphasizes practical approaches to establishing and maintaining such a program. A hypothetical program reflecting the points discussed in the guide is presented. (RE)

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SE 030 948

GUIDE TO BUILDING
EFFECTIVE PRE-ENGINEERING PROGRAMS

A Report of the Pre-College Subcommittee
Committee on Minorities in Engineering
Assembly of Engineering
National Research Council

National Academy of Sciences
Washington, D.C.
September 1979

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JUN 2 1980

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competence and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Copies of this publication are available from

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PREFACE

This is one of a series of publications issued by the Committee on Minorities in Engineering as part of a national campaign to substantially increase the representation of American Indians, Black Americans, Mexican-Americans (Chicanos), and Puerto Ricans in the engineering profession.

Members of the committee serve on four subcommittees investigating the areas or engineering education, pre-college education, manpower utilization, and finance. The committee is a unit of the Assembly of Engineering of the National Research Council (NRC). The NRC is the principal operating agency of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Advice and support to the committee is provided by the National Advisory Council on Minorities in Engineering (NACME), which is made up of the chief executives of corporate and academic institutions, engineering societies, and minority organizations. The council also includes members of the Cabinet and other officials of the federal government.

The primary objective of the committee is to provide effective national leadership in advancing the participation of additional members of minority groups historically underrepresented in engineering, and to coordinate activities directed to achieving that objective. Members of the committee and the council were selected for broad representation of engineering schools and societies, racial and ethnic organizations, industry, and government.

The Committee on Minorities in Engineering and the Pre-College Subcommittee are indebted to Emily Williams, Paul Shapiro, and Charles Martin for their efforts in putting together preliminary drafts of the Pre-Engineering Programs Guide. Their material was used extensively by Ken Smikle in completing this final version.

The Pre-College Subcommittee expresses a special indebtedness to Thomas Litras and L.C. McMillan. A word of thanks is due Ronald Simmons and James Nixon for their comments and contributions. Members of the Pre-College Subcommittee also provided much needed guidance and direction, particularly John Truxal, Barry McLaughlin, George Aguirre, Nathaniel Thomas, and Lucy Sells. Helpful comments were also provided by David Reyes-Guerra and Roy Cowin.

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INTRODUCTION

The career options of a large number of minority students are severely limited in comparison to those of their non-minority counterparts. This disparity persists in spite of the professional-level career opportunities that have been created by affirmative-action mandates and by shortages of trained professionals, as indicated by data from the Department of Labor, the College Placement Council, and from the business and industrial sectors. Minority students have not been provided with adequate information about professional and technical careers, nor the level of academic preparation required for these careers. The Institute for the Study of Educational Policy at Howard University reported in 1976 that the lack of adequate secondary-school preparation, particularly in mathematics and science subjects, was a primary impediment to the realization of the career expectations of minority students (Equal Educational Opportunity for Blacks in U.S. Higher Education, An Assessment, Washington, D.C.: Howard University Press).

Entry into the professional scientific and technological workforce depends on the acquisition of adequate career-related information, and a degree in the desired discipline. Exposure to career-related experiences helps students define the academic paths they need to pursue for entry into the scientific or technological career of their choice. The academic experiences of many minority students, particularly those from the inner city, have been devoid of rewarding or enriching learning experiences, starting with the primary grades. The low expectations of their teachers, inadequate counseling, and exposure to an unchallenging curriculum have kept students from seeing the pertinence of academic preparation to the world of work and the professions. The consequence of these experiences is reflected in many minority students' lack of motivation to pursue the more difficult requisite and advanced academic subjects preparatory to college, particularly mathematics and science subjects, that would assure a broad array of options, such as college education for careers in science, engineering, and technology. Many inner-city minority students are further handicapped by lack of exposure to the scientific or technical professions. The firms that are engaged in these professions are generally located outside urban minority areas. The student's immediate family and friends generally are not engaged in technically oriented employment. Students also suffer from a lack of exposure to role models who could raise their levels of aspiration and

motivation. There are few societal experiences that encourage or reinforce any student's desire to excel academically.

Educators and business leaders, as well as public and private agencies, are concerned with correcting this condition. Business and industrial leaders are concerned with the unavailability of minority professionals trained to assume managerial and leadership responsibilities. Governmental and private agencies are experiencing severe shortages of professional manpower in the areas of energy, transportation, urban development, and health-care delivery. Opportunities for professional-level employment in these and other technological areas will exceed the supply of applicants, with an attendant decrease in equitable employment opportunities for employees with lesser skills. Methods for overcoming the academic handicaps of minority students must be found and applied.

Studies have been conducted that identify the factors contributing to the problems of minority students, and the strategies that can help students realize their potential. One recent study, conducted by the University of California's Outreach Services, suggests that to eliminate the differences in minority and non-minority academic achievement, the educational system must be modified to work with equal effectiveness for all students (University of California, Beyond High School Graduation: Who Goes to College? Berkeley, California, 1978). The study points out that this responsibility does not rest with the junior and senior high schools alone, but with the state's total educational resources, its industrial and business community, and its parent and civic groups. These groups, working together cooperatively, must devise and take corrective measures that will enable minority students to compete with their majority counterparts on even terms. A new thrust or impetus must be given to enhancing the pre-freshman learning experiences of minority students.

The focus of a national effort for the past five years has been increasing minority enrollment in engineering colleges. While significant increases have been realized, it is becoming apparent that further increases in minority enrollment or long-term retention in engineering programs will be impeded unless the numbers of adequately prepared and oriented students coming out of the high schools can be significantly increased. Realizing this goal will be difficult: effective strategies must confront and overcome the problems that have long been effective in negating equitable schooling for minority students. The task is further complicated by the view of most minority and female students that the high school mathematics and science subjects requisite to college-entry preparation are too difficult to master.

The committee concludes that because the solution to these problems is a complex and difficult task, national attention and effort must be directed to the development of effective pre-engineering programs. These pre-engineering programs must: (1) identify students with the potential ability and interest to become engineers; (2) provide academic counseling and assistance that will assure entry into an engineering program or college; (3) supply career-related information and experiences, and (4) make clear to the students the need to relate their academic experiences to their expected careers. The pool of adequately prepared minority students can be substantially increased through such

programs. Further reasonable progress toward the goal of attaining parity representation in the engineering and science disciplines depends on the number of effective pre-college programs that can be initiated and successfully implemented.

This guide has three purposes: to provide practical guidelines for organizing minority-oriented pre-college programs at the local or regional level, or for expanding existing minority engineering programs to include a pre-college component; to describe for a wide audience the current thinking of the committee on the problems faced by minority and female students who might otherwise pursue careers in engineering, and the substance of the programs and projects needed to address their problems, and to serve as a means for disseminating information about unique and useful programs to those involved in the national effort to increase the pool of minority engineers.

To serve these purposes, the committee undertook several tasks: (1) identifying the essential characteristics of minority pre-college programs that will increase the likelihood of meeting the academic and non-academic needs of both students and colleges of engineering; (2) providing summaries of ongoing effective pre-college programs that are being conducted at national, regional, and local levels within several different organizational structures, and (3) developing a pre-engineering program model that identifies the necessary academic and non-academic components, establishes the programmatic and operational relationships of the various elements, and points out factors that must be considered to assure program effectiveness.

Chapter 2 introduces some thoughts on the preliminary assessment of local resources. The concerns and strategies pertinent to two phases of program development are spelled out in Chapter 3. Chapter 4 discusses methods and procedures for acquiring funds to support the program, and Chapter 5, the implementation of a model pre-college program. Chapter 5 also takes up program structures and problems. Chapter 6 describes some successful programs.

This Guide is intended for concerned individuals who are sensitive to the needs of minority students for pre-college programs. It emphasizes practical approaches others have used to serve these needs. The hypothetical program described in Chapter 5 reflects the points discussed in the previous chapters. While the needs of minority students are emphasized in this Guide, the committee notes that female students have historically been underrepresented in engineering professions. The very similar needs of these students can be served by the pre-college programs described here, particularly if the people involved in the programs participate and meet them with concerned attention.

Additional information about specific programs and other efforts can be obtained by writing or calling the committee at the address and number given below. Any user of the Guide can contribute to the fundraising reference materials--which are expandable and offer a means of circulating new information--by sending such material to the Committee on Minorities in Engineering. A list of the users of the Guide will be compiled for disseminating this information, and for furnishing updated material for inclusion in the Guide.

Readers who wish to be included in the list of users, or to contribute reference materials (or both), are encouarged to write or call the committee:

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PRELIMINARY ASSESSMENTS

The implementation of effective pre-engineering programs depends on the availability of various resources, and on bringing them together to serve the anticipated program's objectives and day-to-day needs. Determining whether these resources are available, and assessing their adequacy, is a primary initial task. The conclusions and determinations that emerge from a comprehensive initial assessment of local resources will influence the scope and magnitude of the program. Generally, the committee recommends implementing a program at the local or community level. The magnitude and complexity of the problems that will be encountered will not be insurmountable. As progress is made, and a larger and more comprehensive effort is called for, the experiences, insights, and knowledge that have been acquired will provide a base for effective regional or state-wide efforts. In addition, the personal and other contacts that have been developed can assist in developing a wider circle of contacts and supporters for the expanded effort. It should be noted that this is not a hard and fast rule. Regional and state-wide efforts have been successfully initiated and implemented. The extent of the interest and support of the program's participants will determine the approach best suited to a given area. Detailed descriptions of various programs are available from state and regional directors (such as those listed in Chapter 6), as well as from the pre-college programs office of the Committee on Minorities in Engineering. They can be a source of helpful information.

Assessments should be conducted of the potential contribution of the following resources: the educational system, the business and industrial community, the local minority community, professional societies, regional and national organizations, and government agencies.

EDUCATIONAL SYSTEM

There are three elements of the educational system that will influence the effectiveness of the pre-college program: the post-secondary educational community, the secondary and middle schools, and the local and state educational administration. The assessment of each is briefly described below.

Post-Secondary Educational Community

It is important to determine what post-secondary institutions exist in the area: universities and colleges of engineering, technical institutes, and community and junior colleges with pre-engineering programs. These institutions can provide faculty, students, and facilities to support a pre-engineering program, and help place minority high-school graduates.

Secondary and Middle Schools

At the secondary- and middle-school level, the objective is to determine the educational structure, resources, goals, and key personnel. To assist in planning the program's academic structure, the following questions should be asked:

- What are the percentages of minority students?
- Where are they located? In what classes, what academic "tracks"?
- What is the curriculum, especially in advanced science and math, and what is the level of participation by majority and minority students in Algebra II, Chemistry, Physics, and Trigonometry?
- What extra-curricular activities (math- and science-related) exist--clubs, tutoring, etc.?
- How many minority students graduate from high school?
- How many minority students go on to college?
- How many study engineering?
- How many graduate in engineering?

Many school systems already have a number of activities under way to support the goals of minority engineering and science efforts. It is important to determine the nature of these activities, and to make the best use of them.

Administrative Hierarchies It is important to identify, as early as possible, the school system administrators with whom you will interact in your attempts to initiate pre-college programs within local high schools and middle (or junior high) schools. The initial contact with the principal or headmaster of potential school sites must, in most instances, be authorized by someone higher in the school-system hierarchy. It is an advantage for this "blessing" to come from a recognized, authoritative source. Securing it, in some cases, involves starting at the state department of education and proceeding through the chain of command to the local level. The advantage inherent in this approach of working from the top down is that a lower-level administrator will be inclined to be more cooperative when he or she realizes that approval has been granted at the higher level. The procedure is political in nature, and it requires a good working knowledge of school-system politics at the state and local level.

BUSINESS AND INDUSTRIAL COMMUNITY

Possibly the most highly motivating factor for minority youngsters in choosing an engineering career is the opportunity for employment, career development, and involvement in solving the technical needs of society. Each industry will vary in its mix of engineering-related job opportunities. NACME-member companies (listed in the Resource Directory compiled by the committee) are a key starting point in assessing opportunities and resources, but other industrial companies with a scientific or technological base, federal laboratories, and research centers also have a responsibility to commit their organizations to minority engineering efforts. Most major industrial companies have an affirmative action program (AAP). The section or office of these programs directed to the local community will be of particular interest and help in planning local minority engineering programs. In determining the industrial potential in your local community, you will need some basic information about the industries' status in your community. There are a number of questions you may wish to explore:

- What are the major industries in your community?
- How big a facility does each have in your community?
- Which employees play key roles in local community activities, (school boards, elected officials, Chambers of Commerce, officers in minority groups, etc.)?
- Are there minority engineers within local industry who would be potential candidates for contact with local minority youth?
- What minority talent exists in the private sector?
- What are the activities currently under way to advance minority technical education?
- What is the level of interest and receptivity on the part of industry in participating in the program?

Although minority students may not obtain engineering jobs locally, the attitude of local industry greatly influences their decision to pursue engineering careers.

LOCAL MINORITY COMMUNITY

In assessing the local minority community, it is important to determine answers to the following questions:

- What is the minority population and percentage of each minority group in the local community?
- What are the demographic and other characteristics of the minority community; for example, its income levels, patterns of settlement, and trends?
- Who are the leaders in the minority community?
- What minority-related group organizations are represented in the local community? How can they lend support to your efforts?
  - --National Association for the Advancement of Colored People (NAACP)
  - --Urban League

--League of United Latin American Citizens (LULAC)
--Opportunities Industrialization Center (OIC)
--Local sororities and fraternities
--PTA and other parent groups
--Civic clubs, church groups, business groups, and veteran's organizations
--Action For a Better Community (ABC)
--National Alliance of Businessmen (NAB)

In a general way, it may be possible to characterize some communities by the degree of involvement in their schools and the support they give them. Support may result from an expanding population and economic base; distrust and turmoil from a desegregation plan. In any community, there may be a long-standing tradition of strong parent-teacher cooperation, for example, or there may be a new grass-roots organization to which the superintendent looks for advice. These groups can be very helpful in implementing a local project, and their participation is essential for the project to be successful.

SCIENTIFIC AND PROFESSIONAL SOCIETIES

Local engineering and technical societies, and branches of national professional groups are also sources of human and technical resources, particularly those groups that maintain significant programs in guidance, motivation, and minority engineering education. (See the committee's Resource Directory for a list of scientific and professional societies.)

REGIONAL RESOURCES

Several resources exist at the state or regional level (or both):

- Sources of funding for educational programs
- Educational information agencies providing student-related data, lists of educational agencies and staff, and curriculum materials
- Regional programs, consortia, and directories of professional groups and business organizations, including regional members of NACME.

All these regional sources can offer assistance, advice, and support to the program, and should be investigated to determine their availability and possible level of assistance.

NATIONAL RESOURCES

At the national level, support can be obtained from the following agencies and organizations:

- Committee on Minorities in Engineering (CME)
- National Advisory Council on Minorities in Engineering (NACME)
- Engineering professional societies

- Federal agencies, such as the Department of Health, Education, and Welfare, the Department of Energy, and the National Science Foundation

These national resources can be helpful in supplying academic materials and data, program information, and funds. The list does not include all available resources. Efforts directed to finding support at the national level will produce innumerable resources, all of which can provide meaningful contributions.

3

DEVELOPING A PLAN

Setting pre-engineering and minority programs in action requires strategies and efforts sufficient to carry the program through two developmental phases. In the first phase, the program is conceived and initiated, and the first steps are taken to establish a working organization. In the second phase, the working organization is consolidated and strengthened, and the program's elements are set in order for effective long-term activity.

PHASE I

In this section, we will be looking at the formative stages of a program--organizing initial actions, and establishing a working organization.

ORGANIZING INITIAL ACTIONS

After assessing existing resources, the next order of business is to develop a local program plan. For a project to be initiated, an action-oriented approach must be taken. As previously noted, some actions will be dictated by the needs particular to a given community. There are certain aspects of program planning, however, that apply in a general way to most locales. Some of these are detailed in the following descriptions.

Program Coordination

In many (if not most) successful programs, at least one identifiable person or a small group of two or three people have taken on the responsibility of getting things started. These single individuals or small groups have been astute enough to know who they need to involve in their locales from industry, higher education, the local minority community, and local school district. Each acted as the agent to interest others, bring people together, and see ideas through. Such an individual or group is indispensable in initiating and implementing a successful program.

First Meeting

The first meeting frequently sets the tone and affects what comes later. In some cases, the first meeting may be among local industrial representatives to explore a joint commitment. In others, it may be with selected representatives of higher education, the secondary schools, leaders of the local minority community, and the representatives of local professional and technical societies. Whoever takes the initiative can sound out other interested individuals, and decide who to include in later meetings.

Some combination of the following topics might be included on the agenda for the first meeting:

- Review the students' and the school system's needs and problems.
- Show an audio-visual presentation, such as "A Good Place to Start," by E.R. Kane (structured to bring corporate executives to an awareness of the needs of minority students).
- Distribute handouts describing minority programs and engineering careers.
- Develop local program objectives and approaches based on local needs. Use an applicable program model as a guide, and modify it to fit local needs and resources.
- Generate ideas to develop a community-wide support and awareness campaign by establishing a community-based organization for this purpose.
- Ask for recommendations on ways to increase the number of interested participants. Seek the involvement of those attending in carrying through on these recommendations.
- Establish regular meetings and agenda items.
- Set schedules for completion of specific tasks.

Continuing Contact

Following the first meeting, a small designated task force should take the lead in expanding and maintaining contacts. This can be accomplished through additional meetings and presentations on the proposed program to interested parties in the community. Personal letters and phone calls should be part of the over-all visibility campaign in the initial phases of the program.

Follow-On Meetings

Subsequent meetings should be structured to carry forward the agreed-upon plan of action. It is imperative that the membership of the initiating group be kept large enough to accommodate the increasing number of tasks to be performed. Task forces made up of individuals with appropriate skills should be formed to investigate and develop particular resources, as listed below:

Task Force	Resources to be Developed
Community Involvement/Membership	Professional societies, teachers, parent groups, businessmen and businesswomen, community and civic groups.
Education	State and local educators and administrators, school systems, colleges of engineering, community and junior colleges.
Program Structure and Planning	Regional programs and directors, regional NACME members, secondary and post-secondary educators.
Finance	Sources of funding, including local and state educational programs, local and regional industrial and business organizations, foundations and federal agencies.
Advisory Board	Educational community, professional engineering community, and philanthropic organizations.

ESTABLISHING A WORKING ORGANIZATION

Whatever the nature of the project established, it will need an administrative structure and an advisory board. Advisory board membership should reflect those organizations listed under "Resources to be Developed" above. Some advisory boards of local pre-college programs have included student and parent representation. Local conditions and needs should dictate whether they are included in the initial efforts. The interim responsibility and working space for program development can be selected by convenience and availability (e.g., the administration office of a local school district or industrial site, or local minority organization headquarters) while the project is in the planning phase. The location and primary responsibility for the program itself can be moved or changed, if necessary.

The most essential point to remember in organizing local projects is to get top-level support and commitment from participating parties: the superintendents of local school districts, directors of curriculum, representatives of corporate management, local minority leaders, presidents and deans of colleges and junior colleges with engineering programs. To obtain this cooperation and assistance, a complete description of the program will have to be drafted, possibly by the members of the education task force. Goals, objectives, staffing, and what the program is designed to accomplish should be spelled out in detail. This document is essential to sell the program to potential supporters, and its early completion should be encouraged and expedited. As a general rule, this task must be completed before undertaking any other activity. The document describing the program is necessary to persuade school systems, funding sources, and all other contributors to help meet the program's needs.

PHASE II

The second, or operational, phase of the project is concerned with firming up the working organization that has been established, and with consolidating elements of the program for effective operation. The following sections discuss the program elements as they relate to the over-all structure of the program model. These elements are grouped under the following categories: program staff, program sites, identifying students, student orientation and motivation, curriculum structure, student support services, parental awareness and involvement, mobilization of resources, program evaluation, budget considerations.

PROGRAM STAFF

Coordinator's Role

The person or groups responsible for evolving and acting on the strategies associated with the start-up phase of the program will probably take responsibility for coordination. As a general practice, one person is selected to act as program director. The director has the obligation to ensure that the program meets defined objectives in an equitable manner. In this capacity, he or she works closely with the support staff, as well as with others affecting the program in any way.

Support Staff

The size and functions of the support staff will be determined by the scope of the program. In general, it will consist of the members of a central committee who are responsible for defining the path the program will follow, as well as determining the types of materials and methods to be employed. Members of the various task forces, school staffs, college faculty, and academic support staff (tutors), as well as general administrative assistants can be invited to serve on the central committee and the administrative or operational workforce.

PROGRAM SITES

School sites in areas where high concentrations of minorities live--generally urban areas--are the natural targets of a program. Consideration must be given to the total number of schools that can be included in the program. The desire to serve as many students as possible must be tempered by the resources at the program's disposal, and by recognition that knowledge will evolve and grow about intervention strategies and how best to apply them. Nevertheless, a sufficient number of students and schools must be involved to establish the program's influence and validity. Local circumstances will have to be the determining factor in decisons about the size of the program.

IDENTIFYING STUDENTS

Local pre-college engineering programs must concentrate on identifying minority and female candidates by informing them of career opportunities within the field of engineering, and motivating them to pursue those opportunities.

Minority students with an aptitude for mathematics, science, and engineering may not be easily identified in their middle-school (or junior high school) years, as many minority students are reluctant to pursue difficult academic subjects even if they have the ability to master them. A number of methods can be used to identify such students. The objective is to identify minority students with the potential to succeed in engineering-related studies, and the interest to pursue them. The purpose of the pre-college program is to concentrate efforts on those students with potential. It would not be appropriate to try to sell engineering careers to all minority youth: the selection process is necessary to avoid false promises. Some of the possible ways to identify students with potential are:

Recommendations of Teachers

Committed, sensitive teachers can identify the students who could do well in technical fields of study from their classroom observations and interactions. They would also be able to identify students who could perform well if adequately motivated.

Recommendations of Counselors

In talks with students and parents, knowledgeable, unbiased school counselors can identify students with special interests or abilities. It is important that staff personnel in general--teachers and counselors in particular--are provided with information about the opportunities that exist in engineering careers for minority students. In too many instances, they are totally uninformed and cannot discuss what engineering is all about, or the responsibilities and academic preparation required for the various disciplines. This condition must be corrected in the interest of providing proper guidance and counseling to students.

Personal Contact with Students

Contact can be established directly with individual students in a variety of ways. Motivation, interest, and perhaps conceptual ability or potential can be assessed. Contacts can be made during classroom presentations, tours, and orientation programs.

National Merit Scholarship Corporation (NMSC)

The National Merit Scholarship Corporation conducts a national search competition for all students through its National Merit Scholarship Program and National Achievement Scholarship Program. Entrance into the competition is through the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT/NMSQT). The Achievement Program is for black students only; the Merit Program is for all students. Listings of the top high school seniors planning to study engineering can be obtained from both programs. Such students identifiable as targeted minorities are appropriate for follow-up.

National Engineering Aptitude Search Conducted by JETS

JETS--the Junior Engineering Technical Society--conducts the National Engineering Aptitude Search, a test series that helps predict probable future success of students in engineering. The test fee is $5.00 per student.

Differential Aptitude Test (DAT)

This test is primarily an ability test, rather than an achievement test, and it has been used for a sufficient number of years for extensive longitudinal studies to have been produced on its effectiveness. It is suggested that this test be given to students in junior high school.

STUDENT ORIENTATION AND MOTIVATION

Pre-college engineering activities should be designed to improve self-esteem and to encourage qualified students to study quantitative subjects and develop their skills in communication. Activities may include (but are not limited to) field trips, role-model interactions, tutoring, experience in technical work, career days, recognition and award days, and summer activities. The following activities can assist in informing students about engineering:

Classroom Presentations

Reaching minority youth in the classroom can be one of the most effective and productive approaches.

- Gain the acceptance of the administration. The endorsement of the program by school administrators is as important in the school system as gaining the approval of management in industry. First, approach the superintendent of schools or another key contact(s) to obtain approval of the program plan. Ask for guidance in approaching lower-level administrators in the system. Work toward gaining entry into an identified school site (or sites) that can benefit from the program.

- The next step would be to take the message to others in the school system; for example,
  - --The person (or persons) in charge of curriculum development and instruction
  - --Principals
  - --Heads of school boards
- After receiving the endorsement of the administrators, the next step would be to get in touch with science and math teachers in the selected school(s). They are an important source of information and motivation for young people, and they can be effective in introducing the career choice of engineering.
- Classroom presentations can cover a wide range of topics:
  - --The movie "A Piece of the Action" could be shown if junior high students are involved, or "Nothing But Common Sense" for high school students. (See the CME document, "Engineering--A World of Possibilities," for a listing of available material.)
  - --A career discussion could be held in connection with the film. Subjects could be: why engineering is a good profession, what an engineer does, and career opportunities in industry.
  - --Handout material could be provided.

The presentation should include minority professionals, particularly engineers, who can relate their experiences to the students, and serve as role models.

It is vital that teachers are involved in contacts with students. When giving presentations, encourage them to stay in their classrooms and participate. Get them involved. The message is as important for teachers as it is for students. Teachers need to be made sensitive to the opportunities available to minority students, and to these students' particular needs. In addition to their experience and teaching skills, teachers must bring innovative counseling, teaching methods, and philosophies to the task of correcting the academic disadvantages of minority students.

Field Trips

There are many facilities in and around virtually every community that can be used to inform and motivate students about engineering. Some examples of places to visit are:

- Science museums (especially those with "hands-on" experiments and demonstrations);
- Dams, bridges, transportation facilities, power plants, water or sewage treatment plants, waste disposal sites, and public works projects are all places where the work of engineers can be seen;
- Industrial plants in the community, and
- College and junior college campuses with strong engineering departments and extensive lab facilities for each discipline.

CURRICULUM STRUCTURE

The curricula in a given school may or may not be adequate to the task of preparing students for entry into college. This is particularly true in the sciences and math. It is also possible that the material as it is structured may be too difficult to absorb. This is a critical condition that needs to be corrected, particularly at the junior high school level.

The determination of the adequacy of the material, how it should be restructured, and how it should be presented can have a profound effect on the normal functions of the school. The principal and heads of departments may be reluctant to disrupt established practices. While it may prove difficult to alter an entire course of study, the use of new materials, developed as modular additions to existing work, can be added to established courses with minimum disruption. Of particular value is the material prepared by the National Coordinating Center for Curriculum Development (NC^3D) at Stonybrook, New York. These new curriculum materials in science, mathematics, and communications are designed in modular form, and are intended to complement regular high school curricula. This source of assistance should be fully exploited.

Aside from new materials, many schools offer a specific curriculum to students preparing for college. In many instances, minority students have been directed away from these courses. Every effort must be made to ensure that potentially qualified minority and female students have the opportunity to take advanced academic course work.

A further requirement that must be met is that the coursework in mathematics, science, and communications is at a level sufficient to prepare students for entry into freshman engineering programs. The magnitude and sensitive nature of the tasks necessary to providing adequate academic preparation for minority students require expertise in several areas. The cooperative efforts of high school staff and post-secondary faculty, among others, will be vital.

The support and help the students receive will be provided by high school teachers, college faculty, and supplementary tutors. The skills and commitment of this support staff must be adequate to the task. The results of their involvement will determine the success of the program. It is the director's responsibility as well as that of the related program staff, to ensure that this element of the program receives adequate attention and direction.

Depending on the receptivity of the schools, it may be possible to incorporate new material into ongoing course work, relying on the teachers' expertise and judgment. In other instances, it may be necessary to provide new material to the student after regular classes and on Saturdays. The summer vacation period can also be used to advantage. In approaching these tasks, it is important to determine the extent to which students' schedules may have to be changed. Keep in mind the conservative nature of the administrators and staff that you will be working with. Don't expect overnight and abrupt changes. Your program may not achieve immediate results: the experiences of others in similar endeavors indicate that progress is accomplished over some time, and is based on constructive, well-conceived, and mutually agreed-upon strategies.

STUDENT SUPPORT SERVICES

It should be recognized that the majority of urban minority students who will be directed to college preparatory courses in their junior high school years will be handicapped by their past academic experiences, and these may have been bad in spite of the students' potential. Lack of good study habits, inadequate comprehension of math and science concepts and techniques, and a lack of understanding of the discipline and commitment necessary to pursuing an intensive academic program will impede the student's progress and dampen his or her desire to prepare for a technical career. Those students who experience difficulties and do not do well need additional attention. This can be furnished through tutorial services, after-school classes, specialized materials such as those developed by NC³D, personal attention and assistance from an older high school or college student, and similar efforts. Emphasis on study, comprehension of materials, and motivation will produce positive results. This entire set of services should be geared to elevating the student's academic performance. At the point where students begin to experience significantly improved academic performance and start obtaining A's and B's, rather than D's and F's, they will become strongly motivated and oriented to achievement.

PARENTAL AWARENESS AND INVOLVEMENT

Parents are a vital link in supporting and guiding students. They need to be made aware of the rewards of a professional career in engineering, the level of commitment, and the amount of study that is required to attain these rewards. Their support and encouragement can exert considerable influence on students to work and study at the required level.

The engineering profession has such low visibility in most minority communities that special efforts have to be made to inform the parents of students participating in pre-engineering programs that academic preparedness is the key to entering engineering colleges. Some means for heightening parental awareness include:

- Personal Contacts Direct personal contact by school administrators, guidance counselors, teachers, and others could be one approach. Sitting down in a student's home with his or her parents, or with a small group of parents, to explain the program could be one of the most effective ways of informing parents.
- Parent Site Tours Parents should be included on site tours, where this is appropriate. They can then learn about engineering opportunities first hand, and help motivate their children.
- Contact Through Local Parent Organizations Parents of minority youth might be reached through local parent organizations (PTA, church groups, etc.). A meeting would be arranged at which minority engineers could discuss career opportunities.
- Dissemination of Informational Literature The Urban League in Cleveland, Ohio, has sponsored a Parents' Informational Program for Engineering (PIPE - Line). Established in 1975 as an outgrowth of the Cleveland Urban League's Engineering and Technical Outreach Program,

PIPE was developed to increase the number of minorities in engineering and architectural fields. PIPE organized college workshops and visits to industrial plants and facilities, involving more than 100 black and Puerto Rican parents in a series of Saturday sessions. In addition, some 1,000 parents were reached in a survey conducted among minority parents about engineering as a career choice. As a result of their participation in the program, the parents expressed a greater appreciation of engineering as a career choice, and said it increased their ability to assist their children in selecting careers.

MOBILIZATION OF RESOURCES

Local minority-in-engineering programs need to tap the resources of industry, engineering firms, junior colleges and colleges of engineering, minority civic organizations, and all levels of government. The program's efforts might be linked with those of other minority organizations and the recruitment programs of local industry. Other activities to mobilize resources might include developing slide presentations, journals, newspaper articles, ads on radio and television, exhibits and displays. Local community resources are vital elements of successful projects. Their support (in the form of funds or manpower) is essential to the success of pre-college engineering programs. Many projects, aside from the major consortium efforts, have emerged from the community itself. Some examples are given below. Wherever possible, a working relationship should be established with such a group or groups, to benefit from their experiences and advice.

Inroads

INROADS is a career-oriented program to motivate minority college students to pursue careers in accounting, engineering, and business management. The program began in Chicago, and now has regional offices in St. Louis, Milwaukee, and Cleveland. In each city, INROADS acts as an active agent to bring together local industries and four-year colleges and universities. Local industries provide minority role-model personnel who work closely with the INROADS staff on projects with the students, and career-oriented jobs. A student works successive summers for a corporation, gaining work experience in his or her major field of study. The student may then obtain full-time employment with the corporation on graduation from college. INROADS handles the initial screening of students, and provides them with year-round counseling and training. The educational institutions provide tutorial and other special program assistance designed to help students with college-curriculum courses. INROADS also operates pre-engineering programs in two cities in cooperation with Upward Bound and local colleges of engineering to help prepare minority students majoring in engineering. At both the college and high school levels, recruiting efforts are primarily directed toward ghetto youth.

The National Scholarship Services and Fund for Negro Students (NSSFNS)

The National Scholarship Service and Fund for Negro Students is a non-profit college advisory and referral service for black and other minority high school students. The service is also open to Upward Bound and Talent Search students without respect to race, color, or creed.

NSSFNS seeks to:

- Increase the pool of trained blacks and other minorities through the direct counseling of those students seeking to enter college;
- Raise the level of expertise in counseling and guidance available to minority students, and
- Raise funds to provide supplementary scholarship assistance for minority students receiving inadequate packages of financial aid.

NSSFNS provides assistance to high school students seeking information on the admissions policies and financial assistance available from post-secondary institutions. Students who complete an NSSFNS student application receive a student referral report listing the educational institutions of particular interest to them.

Two basic elements are used to produce a referral report:

- The NSSFNS student application submitted by the student while in high school, and
- The NSSFNS data bank, which contains up-to-date information on about 3,000 post-secondary educational institutions. The personal information from the student's application is matched with college information in the data bank. The student referral report contains comments on four colleges, and as many as five alternative schools.

National Council of La Raza

The National Education Task Force of La Raza is concerned with educational opportunities for Spanish-speaking students, particularly Mexican-Americans. For the past seven years, its national office has been located at the University of New Mexico in Albuquerque. Regional offices are now maintained in San Antonio, Texas, Denver, Colorado, Sacramento, California, and the University of Wisconsin in Milwaukee. This program seeks to provide teenagers of Hispanic origin with a wide range of guidance, tutoring, and other supportive services.

League of United Latin Amercian Citizens (LULAC)

With the opening of a new office in Philadelphia, the National Educational Service Center, Inc. (which is part of LULAC), now operates 12 educational outreach programs across the country to increase the opportunities for post-secondary education available to Hispanic youth. Founded just three years ago, the programs have counseled more than 40,000 students, placed 14,000 students in undergraduate and graduate

institutions, and channeled $11.5 million in financial aid to these students.

Committee to Increase Minority Professionals in Engineering, Architecture, and Technology (CIMPEAT)

In addition to serving as the southeastern regional coordinator for MI³ (described in Chapter 6), the Atlanta-based CIMPEAT has developed a pre-engineering program. This program provides services to junior and senior high school students, counselors, math and science teachers, other school personnel, and parents. A total of 28,739 individuals participated in the program in 1976.

University of New Mexico in Albuquerque

The university's College of Engineering conducts a Summer Institute for American Indians. Its purpose is to introduce students to engineering before they commit themselves to enrolling in a formal academic program. Among the students in the class are representatives of the Navajo, Pueblo, Ottawa, Mohawk, and Blackfeet Nations. This program also sends engineering graduates back to the reservations to talk to high school students about engineering careers.

The National Hispanic Scholarship Fund (NHSF)

The National Hispanic Scholarship Fund is an organization that provides scholarships for undergraduate and graduate students of Hispanic background. These students attending a college in the United States may be of Mexican-American, Puerto Rican, Cuban, Caribbean, Central American, or South American heritage. The organization apportions funds to reflect the national distribution of the Hispanic population, and works to close the educational gap between Hispanics and the general population of students.

The selection criteria for NHSF scholarships are applied uniformly throughout the United States. Candidates are chosen on the basis of academic achievement, personal strengths, leadership, ability to complete higher education, and financial need. The National Hispanic Scholarship Fund (incorporated in San Antonio, Texas, in 1975) has worked to establish itself as the appropriate source for the dissemination of national scholarship funds. The Fund has nearly doubled the amount of contributions received and the number of students receiving awards. Successful recipients come from more than 75 percent of the states in the country. The colleges and universities these students attend typify the higher education institutions of the nation. The variety of majors in which they are involved assures that they will be making significant contributions in areas where equitable Hispanic representation is now lacking. Some of these areas include the engineering disciplines, medical sciences, education, and the social sciences.

Society of Hispanic Professional Engineers (SHPE)

This organization, based in Los Angeles, California, seeks to increase Hispanic participation in engineering and technology by:

- Improving the quality of education and training programs to prepare Hispanic students to become professional engineers;
- Developing and instituting programs that will assist Hispanics considering engineering as a profession, and
- Increasing the number of Hispanics entering the field of engineering.

The activities SHPE undertakes to advance these general goals include:

- Conducting programs that encourage Hispanic youth at the elementary, secondary, and post-secondary levels to consider engineering as a career;
- Providing financial assistance to students enrolled in engineering programs;
- Consulting industry on methods of implementing affirmative action programs and goals;
- Monitoring the success of Hispanic engineering students and professional engineers, and
- Developing a talent pool of Hispanic engineers for referral to potential employers.

The organization publishes a newsletter for nationwide distribution, and a directory of Hispanic professional engineers.

Other resource mobilization activities may also include programs to increase the sensitivity and awareness of corporate personnel. The E.I. DuPont Company, among others, has developed media material that can be used effectively in such programs. Information about media materials can be found under "Reference Materials" in the CME document, Engineering--A World of Possibilities, Washington, D.C., 1979.

Corporate awareness programs can be used to secure minority engineers as role models and guest speakers, make students aware of available jobs, and provide a means of identifying and recruiting highly sought-after students for summer employment (as well as permanent employment).

Media campaigns can enhance the visibility of the local pre-college minority engineering programs. Newspaper articles, displays at the conferences of national scientific and professional societies, and exhibits are all opportunities for marketing your local program. A more extensive listing of organizations and programs that can serve as resources is provided in Chapter 6.

EVALUATING THE PROGRAM

Programs should make provisions to include an evaluation component within their programmatic structure to permit systematic assessment and evaluation of the program's performance in accomplishing its stated

objectives. This information should be used to correct strategies and restructure program elements. A determination will have to be made about the methods that will be used to measure progress in meeting program objectives, as well as how the information will be used to improve program performance.

BUDGET CONSIDERATIONS

The budget restates the program plan, translating program elements into expenses. In the beginning phases of the program, costs will be minimal. Such expenses as mailing, phone calls, and rent, if any, can be covered by out-of-pocket donations of the program staff, business, or civic groups. As the program grows and expands, the attendant costs will increase to the point that sizable grants or donations will be required. At this point, the active development of funding sources will become necessary. Considerable time and effort will have to be devoted to this activity. Chapter 4 treats the subject of funding in detail.

4

DEVELOPING FINANCIAL SUPPORT

The level of success achieved by any minority engineering program depends heavily on the funds available to support an ongoing successful effort. Most people are reluctant to ask for money, and approach the task as though it were unpleasant but necessary business. Most people realize they lack the skills and experience to develop funds effectively.

Two realities should be kept in mind. First, no organization can function or survive without adequate funds. Second, the sources from which you request funds, whether foundations, corporations, individuals, or the government, expect and need to be solicited. In addition, funds have been allocated to be given away and it is up to the seeker of funds to present the right proposal through the right person to the right potential donor to receive them.

The purpose of this chapter is to provide guidelines for this process. Practical considerations limit the scope of the material that can be presented here; however, the suggestions offered can assist in soliciting financial support for minority pre-college and engineering programs from the following sources: the private sector, the federal government, and state governments. The structure, major components, and other features of a typical proposal are presented under "Proposal Format."

PRIVATE-SECTOR SOURCES

Four elements are essential to obtaining funds from foundations: the idea to be sold, likely sources of support for that idea, good presentation of the idea to the identified potential sources of funding, and adequate follow-through after the presentation.

The areas within the private sector that can be cultivated in the development of funds include:

- Private foundations;
- Corporate foundations;
- Corporate public relations and college relations departments, as well as community affairs offices;
- Private individuals.

The Idea--Initial Considerations

If it is possible, a board that includes business executives, or a committee of volunteers should be formed to raise funds. The people serving on the board or committee must be willing to make calls to solicit funds on behalf of the program. It is necessary that these people have some familiarity with fund-raising techniques, and some standing in their business or professional communities. Foundations give to people in most instances, not to projects, and they prefer to give to people they understand, who speak the same language, and with whom they feel comfortable. The program must be sound, of course, but it must also be represented by individuals who can legitimately present it to a potential donor. The program director may assume the responsibility for developing funds. In this case, the director will need prominence in his or her profession, a wide circle of influential contacts, good writing skills, and good sales ability.

The board, committee, or director seeking to raise funds for the program should follow four basic steps:

- Identify all potential sources of funds in each of the groups--private foundations, corporate foundations, and philanthropists;
- Develop a strategy for approaching each group;
- Follow through on all phases of the strategy, and
- Cultivate the sources that support the program.

These are spelled out in detail below.

Identification of Sources of Support

To identify potential sources in each of the groups is a time-consuming but necessary step. Identifying individuals who provide support for local and regional efforts is a largely untapped funding resource for minority programs. Locating these individuals is a process that should start with your financial committee's work in your community. Find out who serves on the boards of major corporations, colleges and universities, hospitals, and museums in your area. You can obtain this information from the annual reports of these groups. You will find some names appearing again and again. Concentrate your efforts on developing these individuals as possible contacts for sources of funds. The members of your committee should know a substantial number of these people personally. Committee members can be effective in getting in touch and selling the program to them. If your program is affiliated with a university, it is possible that officials, alumni, students, affiliates, or interested groups may have connections with the potential funding sources. Such individuals or groups can also provide access to both local and, in some cases, national foundations.

The direct-mail approach to generate funds is a costly and drawn-out process. A principal key to success lies in obtaining appropriate lists of individuals or organizations to whom you can mail your requests. Commercially available lists are not your exclusive property--others can buy and use them. You will probably have to generate your own lists and keep them up-to-date. It is a long-term endeavor, and the return from

initial efforts is not likely to generate start-up funds. There are exceptions, of course, and decisions about direct-mail campaigns should be dictated by local conditions. Direct-mail approaches are poorly received by funding sources. A form letter cannot convey the same personal appeal to all recipients, and it is impossible to know what a funding source wants through a direct-mail campaign. It is far better to send general information on a program, rather than a request for funds. This will expand a program's contacts without alienating possible sources of funds.

Prospective donors among foundations and corporations may have been partially identified by your committee. A more complete identification of possible donors can be gained from directories such as Standard and Poors, the College Placement Manual and the Foundation Center Source Book Profile, for instance. Directories of corporations within each state are readily obtained from public or college libraries. These list the size of the corporation, in terms of employees and gross business, the officers and location of corporate headquarters, and related information. This background information can be useful in approaching corporate officers. The time spent in researching and identifying probable funding sources will pay dividends in terms of funds, and reduce wasted time and frustration.

Methods of Presenting the Idea

The presentation should be made through a two- or three-page description of the program or case statement. The case statement should tell what the program will do, why its services and functions are needed, why it should be supported, and what funds it needs to operate properly. Because most foundations prefer to provide start-up or "seed grants," they will want to know how you are going to keep your program going when their grant funds are depleted. "Is there any way you can become self-supporting?" is a question they will ask sooner or later. Planning future funding strategies is essential to securing the program's future. Can the program be funded by "federal title" money or not, and for what length of time are questions (among others) to be considered initially in the program. Several points should be made in describing the program to potential donors; for example,

- The essential need for the program, and a timetable to meet specific needs;
- How your program can address stated needs and problems better than existing agencies;
- The program's urgency and sincere intent.

Present your case clearly and briefly.

Once the document is in its final form, how do you approach likely foundations? We must again stress the importance of the "people-to-people" approach. Do not write a letter. All foundations receive innumerable letters requesting assistance. Although the larger foundations generally read them, smaller foundations cannot afford the staff time. Use the phone to make an appointment. If possible, the volunteer or the director (or both) should make the presentation. A

successful presentation will result in a request that you submit a formal proposal. Some general guidelines for generating an acceptable proposal are discussed in a later section of this chapter ("Proposal Format").

Follow-Through

All visits should be immediately acknowledged by a brief thank-you letter. Any materials the potential donor has requested should be sent promptly. If the material is a proposal, it should go under separate cover at the request of the committee member who made the presentation. Send a copy of all correspondence to that committee member. A follow-up phone call should be placed a few days after the requested material has been sent to check that it has been received. If and when a grant is received, notify the volunteer. Acknowledge his or her help in receiving the award.

Once the contact has been established between the program and a potential foundation source, keep it alive. Inform the potential donor about the program's activities during the period you are waiting for an award. It is a good idea to keep the foundation informed of a program's activities, progress, and results after an award is received, particularly if you expect to return to the donor for another award.

FEDERAL FUNDING SOURCES

A large number of agencies and grant-in-aid programs can be used to develop funds. The Office of Education (OE) within the Department of Health, Education, and Welfare, (HEW), the Departments of Energy and Labor, National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF), are all possible sources of funds. Considerable effort attends tapping these sources of funds. The reference material accompanying this chapter provides information that will assist the program director and his or her committee in becoming knowledgeable in this area. Compiling a comprehensive library and subscriptions to documents such as the Federal Register, the Commerce Business Daily and the Directory of Federal Domestic Assistance are musts. Knowledge concerning the various public laws and legislation and their implications for funding is mandatory if federal sources of funds are to be fully exploited.

It is possible to obtain most of the background information needed about the federal agency and its specific types of grants by sending a letter of inquiry to the funding agency. Request information concerning:

- The correct name for the specific grant-in-aid program or program category under which the application should be made;
- The amount of money available in the current fiscal year for this category, and how much of the available funds the agency expects to use for re-financing ongoing projects;
- The regulations developed by the federal agency for the program involved;

- The proposal format and any accompanying federal forms that must be submitted;
- The application deadline and expected review and notification dates;
- The expected average size of individual grants;
- Required local matching funds;
- Restrictions, if any, placed on the use of funds awarded under the program, and
- The name of any other agency that must be consulted in preparing, reviewing, and judging the final application.

STATE FUNDING SOURCES

Information that should be requested from state agencies is very similar to that requested from federal agencies:

- The correct name for the program under which to apply;
- The eligibility requirements for the program;
- Any required matching funds;
- The amount of money available;
- The correct format or application forms to be used.

When seeking support under a federal grant received under a "state umbrella appropriation," you should obtain copies of pertinent regulations, the authorizing law, and the state plan. This last document is frequently required of states to qualify for federal funds distributed by state agencies to local recipients.

WRITING THE PROPOSAL

The proposal document is often the most significant factor in obtaining approval of a project by a funding agency. It should be well written: clear, concise, and readable. Avoid the use of jargon. The proposal should demonstrate:

- That the idea for the project has merit and addresses a significant need;
- That the applicant has done a thorough job of selecting methods for meeting this need and of instituting the program;
- That there is a reasonable expectation of success.

Keep in mind that the proposal is your first contact with the funding agency. It bears the considerable burden of creating a favorable impression of competence and organizational ability. In addition to content, the proposal's organization, readability, and effectiveness in meeting the informational requirements of the funding agency are significant. These general instructions should be followed:

- Read all forms and instructions provided by the potential funding agency, and follow them carefully;
- Write with clarity and concision;

- Adapt the language of the application to the audience in the funding agency, explaining highly technical phrases or words;
- Explain all abbreviations and acronyms;
- Ask someone in the program to read the proposal for clarity, grammar, and style before final typing;
- Do not bury the important parts of the proposal behind too many introductory phrases;
- Do not be afraid to use underlining, capitalization, headline titles, etc., as necessary, to make the proposal more readable;
- Do not provide a lot of drawings, charts, or statistical tables in the body of the proposal, unless required by the application forms;
- Do not be too concerned about using the words that are "in" with particular funding sources.

Proposal Format

The major components of a typical proposal, and their usual order, are set out in the following outline.

The Major Components of a Proposal[1]

Topic	Information to be Provided
Title Page	Title of project, name of organization or applicant, name of agency submitted to, inclusive dates of proposed project, total budget request, signatures of authorized personnel approving submission of the proposal from the local agency.
Abstract	Summary of project objectives, procedures, evaluation, and dissemination, usually 250 words in length.
Statement of the Problem	What needs to be done and why. Usually includes references to related research or previous projects that give evidence of the need for the project.
Objectives	The proposed outcome of the project is clearly specified, in measurable terms. Usually, an objective is provided to meet each major need identified in the preceding section.

Procedures	How the objectives will be met. This section may begin with an over-all design or approach for the project, then describe specific activities. It discusses how the population to be served will be selected, outlines management and administrative structure for the project, and provides details on how much time will be needed to carry out the design. Procedures should accompany each objective.
Evaluation	Details the means by which the local agency and the funding source will know the project has accomplished its objectives. Indicates the type of evaluation information to be collected, how this will be analyzed, and gives a pattern for its dissemination and use. Evaluation criteria should be provided for each objective.
Dissemination	How the outcomes of the project will be shared with others. How the products or results of the program wil be transmitted to the field for rapid use, thus maximizing the value of the program. Frequently, this section includes details on reports to be filed with the funding agency.
Facilities	Facilities required and how these will be provided. This section can also be used to explain any special equipment or facilities available to the local agency that will facilitate the project.
Personnel	How many and what categories of employees will be needed for the project. How these will be selected. Information should be provided on the background of key personnel to make evident the local agency's experience and general managerial or professional skill.
Budget	Cost of the project. How much will be required from the funding source and how much will be contributed by the local applicant. A budget is usually divided into categories such as personnel, equipment and materials, travel, physical plant, and indirect costs.

[1]This format was used by Mary Hall in her book Developing Skills in Proposal Writing (Continuing Education Publications, Corvallis, Oregon, 1971).

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5

IMPLEMENTATION

Basic decisions must be made on completion of the preliminary assessment described in Chapter 2: Do the necessary resources exist? Can a program be implemented with a reasonable chance of succeeding? What type of program should be initiated--a local program or a regional consortium? Definite answers must be found to justify the time and expense that will be required to put a program together.

If the conclusions and answers based on the assessment are positive, and a local consortium would best serve the needs that exist at the potential site, then the following steps should be taken: generate an implementation schedule, identify administrative elements, tasks, and responsibilities, and identify educational elements, tasks and responsibilities.

GENERATING AN IMPLEMENTATION SCHEDULE

The implementation schedule would typically include the following tasks and activities, to be performed in the following order:

Total Elapsed Time*	Task/Activity
TBD**	Assessment task force formation and activity
TBD	Approval of program initiation by task force
TBD	Approval of program initiation by educational hierarchy
2-3 Months	Development of start-up and long-term support funds
2-3 Months	Establishment of advisory board/ board of trustees
3-4 Months	Appointment of director and staff
3-4 Months	Formation of committees--education, business, parents, community

Total Elapsed Time*	Task/Activity
5-6 Months	Selection of faculty participants secondary/post-secondary
5-6 Months	Selection of students
7-8 Months	Establishment of business/ industry liaisons
8-9 Months	Development and initiation of in-service workshops for faculty participants (should be conducted during the summer)
11-12 Months	Beginning of pre-freshman program and classes (fall semester)

*From Beginning of Program **To be determined

The approximate time over which the above schedule would be implemented is 12 to 14 months. It is important that the program be initiated and scheduled to take advantage of the enthusiasm and good will of the program's supporters. It is also important that the beginning of the program's classes coincide with the start of the regular fall semester. The schedule given above is appropriate to structuring a local consortium of approximately five secondary schools and three post-secondary institutions, with community and industry support. A schedule for the second phase of the program (described in Chapter 2) is given below.

ADMINISTRATIVE ELEMENTS, TASKS, AND RESPONSIBILITIES

Element/Activity	Responsibility
Form advisory board	The advisory board selects the director, and provides guidelines and direction to entire program. (The advisory board must consist of a cross-section of participants to avoid domination by any one group.)
Select director	The director identifies working staff, and provides day-by-day administrative direction to program.Expedites the formation of various committees.
Establish policies and procedures	The advisory board establishes the procedures and guidelines for conducting the program's business.
Implement policies and procedures	The director carries out policies and procedures established.

Element/Activity	Responsibility
Organize action committees	The director provides assistance in forming the business/industry, education, community/ parent, and other needed committees. The advisory board determines which committees need to be formed, and when.

EDUCATIONAL ELEMENTS, TASKS, AND RESPONSIBILITIES

The educational component of the program should be administered by the education committee. Most of the members of this committee will be selected from the educational community; however, there should also be representation from business and parent groups on the committee.

An implementation schedule should be generated that complements the over-all program implementation schedule. Typical tasks that would appear on the schedule would include:

Total Elapsed Time*	Task/Activity
3-4 Months	Form education committee and elect chairperson.
3-4 Months	Develop teacher selection guidelines.
4-5 Months	Select teachers and confirm acceptance.
4-5 Months	Develop criteria for selection of students.
5-6 Months	Develop guidelines for post-secondary and industry involvement.
6-8 Months	Select post-secondary faculty and business/ industry representatives.
7-9 Months	Select students and confirm acceptance.
8-9 Months	Produce guidelines for curriculum development/enhancement.
9 Months	Develop curriculum components.
8-9 Months	Familiarize teachers with curriculum.
11-12 Months	Pre-freshmen program and classes begin (fall semester).

*From Beginning of Program

The following sections provide brief explanations of particular items in the schedule.

Teacher Selection

Principals and department chairpersons of math, science, and communications should develop specific plans for the selection of teachers to participate in the program. Teachers must be selected by demonstrated sensitivity, ability, interest, and motivation to work with minority students.

Student Selection

Students should be selected on the basis of math and science proficiency, perseverance in completing assigned tasks, and interest in engineering or science.

Selection of Post-Secondary Faculty Advisers

In addition to the attributes listed for selected teachers, the post-secondary adviser must have the ability to provide teachers and students with a clear picture of the academic preparation required for entry into an engineering undergraduate program. These advisers will work closely with the education committee in structuring the program's curriculum.

Curriculum Development

Materials and guidelines are available to assist in developing needed curricula. NC³D at Stonybrook, New York, Project SEED, Berkeley, California (see Chapter 6), and the National Science Foundation in Washington, D. C., can assist in this task. They will also furnish academic materials and conduct workshops for teachers who will be using them.

Selection of Industrial Representatives

To broaden the students' view of the requirements of a career in science or engineering, opportunities to visit industrial sites, to talk to practicing minority professionals, and to gain work experience must be provided. Industrial representatives can help in identifying and providing these opportunities.

Summary

The implementation of a pre-engineering program is a time-consuming, complex task. The strategies and guidelines contained in this manual should provide directions, and the regional and national resources listed will provide further assistance. Keep in mind that local situations will probably vary, dictating modifications and departures from the strategies described here. The collective judgment of all participants will provide the realistic and workable strategies needed.

6

EXAMPLES OF SUCCESSFUL PROGRAMS

To provide an overview of the minorities in engineering effort, this chapter offers brief descriptions of organizations and activities at three levels: national, regional, and local.

NATIONAL ORGANIZATIONS

Organizations conducting activities at the national level are concerned with (1) providing corporate-level leadership, support, and advice to the Committee on Minorities in Engineering, (2) providing guidance and leadership to the minorities in engineering effort, (3) identifying potential minority engineering students, and providing them with career counseling and orientation, (4) developing pre-college curricula that have an engineering emphasis, and (5) providing financial assistance to minority engineering students.

The following are examples of minority-related efforts at the national level:

The National Advisory Council on Minorities in Engineering (NACME) is an organization composed of the chief executive officers of many of the nation's leading corporations, academic institutions, engineering societies, and minority organizations. NACME'S main objectives are:

- To encourage participation by members in advancing the national goal of achieving a tenfold increase in the number of minorities in engineering by the mid-1980s;
- To achieve an interim goal of parity representation of minority students in the freshmen engineering classes of 1982;
- To achieve parity among graduating classes of 1987, and
- To provide financial support to minority engineering efforts.

The Committee on Minorities in Engineering (CME) provides leadership to minority engineering efforts by:

- Defining needs, identifying resources, and recommending activities that seek to develop program opportunities. The committee conducts minority workshops and meetings, and produces reports (for example, on the retention of minority engineering students), and other materials;

• Developing generic models of successful approaches, such as the National Fund for Minority Engineering Students which the committee helped create in 1974, and developing directions for pre-engineering programs;

• Advising and encouraging interactions among appropriate groups, such as industry, ethnic organizations, educational institutions, governmental agencies, and local and regional programs and directors, and

• Communicating and disseminating data, information, and study results through its publications, seminars, and workshops.

Engineers' Council for Professional Development (ECPD) is a council of 19 leading engineering societies representing 750,000 members organized to promote and advance engineering education with a view to furthering the public welfare through the development of better-educated and better-qualified engineers. Among the several means of achieving these purposes is ECPD's pre-college students' guidance program, which disseminates publications, maintains a lending library of films, and sponsors numerous summer programs. A special parallel effort is directed specifically at minority high school students through a series of summer programs.

The summer programs, called MITE (Minority Introduction to Engineering) last one to four weeks, and are open to minority students who have completed their junior year of high school and have generally had three years of math (at least two are required)) and one year of a laboratory science. These programs are on-campus experiences of an engineering education, and provide opportunities to visit and talk with engineers at work and in more informal campus sessions.

ECPD created the Minority Engineering Education Effort Task Force (ME^3) in 1973, and this task force subsequently became an independent group under the same name (described below).

ECPD distributes more than a million pieces of guidance material annually. The current catalogue lists about 50 titles, many of which are minority-oriented.

Junior Engineering Technical Society (JETS, Inc.) has completed 28 years of service to our nation's youth. The program is carried on through club-type activities in secondary schools. More than 2,000 JETS chapters have been chartered. With the assistance of industry and engineering societies, many JETS chapters have been organized with minority youngsters. The minority JETS chapters are active and successful. JETS functions principally at the local chapter level, usually through bi-weekly or monthly meetings. Chapter programs vary widely, but may include industrial tours, speakers, inter-club competitions, technical papers, social events, and recognition ceremonies. Each chapter is provided with a JETS handbook to assist in club organization and programming of activities related to the broad area of technology.

JETS publishes a monthly newsletter from September through May, conducts the National Engineering Aptitude Search, provides materials for interscholastic TEAMS (Tests of Engineering Aptitude in Math and Science) competitions, promotes engineering design contests, and participates in regional and national science and engineering fairs.

The Minority Engineering Education Effort (ME^3) organization has three major areas of activity:

- Identification - Potential engineering, mathematics, and science degree candidates are identified, entered on computerized lists, and tracked throughout their entire pre-college career. Performance data on these students are then made available to universities and colleges for recruitment purposes through the publication of lists three times each year.
- Information - Motivational materials, including films, brochures, and guidance materials are made available to high school counselors, teachers and students. Field support activities include dissemination of resources, role models, speakers, and consulting services to local high schools.
- Support Services - Counseling and student tracking services are offered to local and regional programs and companies.

The National Coordinating Center for Curriculum Development (NC^3D) develops, adapts, and distributes educational curricula for junior and senior high schools. Curriculum efforts draw on practical applications and relate them to associated theory through multimedia educational methods. A curriculum geared more to junior high school students is now commercially available and is known as Technology-People-Environment (TPE). These are short modular instructional programs designed to provide a "hands on" approach to learning the application of technical knowledge.

Other organizations provide scholarships and grants. These include:

The National Fund for Minority Engineering Students (NFFMES) provides scholarships to qualified minority students. The Fund also encourages engineering schools to accelerate their recruitment of minority students.

The National Merit Scholarship Corporation (NMSC) conducts a national talent search through the National Achievement Scholarship Program and the National Merit Scholarship Program. To participate in the National Achievement Scholarship Program for outstanding black students, the students must take the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test while they are still in high school, and indicate a desire to be considered in the Achievement Program. The student also participates in the Merit Program. NMSC makes approximately 100 scholarship awards each year to engineering students through its two talent search programs. These awards are financed by about 40 sponsors of the Achievement Program, and about 150 of the Merit Program.

Specific and detailed information concerning the above organizations is provided in the CME reference document, "Minority Engineering Resource Directory," Washington, D.C., 1979.

REGIONAL CONSORTIA

Consortia have been formed in various sections of the nation with the objective of coordinating and expanding collective efforts for effective pre-engineering programs. These regional consortia have identified program elements and organizational structures that will be most effective in the geographic regions where they are located. Most consortia are located in urban areas, and are targeted at one or more minority groups. They have been instituted by engineering colleges, industry, professional groups, and minority organizations. The composition of these consortia illustrates how various groups within a given region can be integrated to assure the realization of a common goal. The following list provides a brief description of the activities of some of the major consortia:

Philadelphia Regional Introduction for Minorities in Engineering (PRIME) has evolved since its inception in 1974 in Philadelphia into a centrally coordinated network of twenty-eight business firms, seven area universities and colleges, thirty-six middle schools and senior high schools, and several professional engineering societies that serve the school districts of Philadelphia and Chester, Pennsylvania, as well as Camden, New Jersey. Approximately 1,800 pre-college students are affected by a variety of programs and activities sponsored through the PRIME program. PRIME's more innovative activities include: the PRIME Universities Program (PUP), designed to provide an intensive day-time summer program for approximately 400 post-eighth- through twelfth-graders; a Summer Employment/Placement (SEPO) service for PRIME senior high school students; Big Brother/Sister Tutorials; a Minorities-In-Engineering Exhibit in the Outdoor Science Park of the Franklin Institute; a teacher's in-service training program, and special parent counseling. Each of the thirty-six middle schools and senior high schools is matched to the resources of a participating company or government agency.

Forum to Advance Minorities in Engineering (FAME) was founded in Wilmington, Delaware, in 1976. FAME is composed of thirteen corporations, two school districts, the University of Delaware and Widener College, as well as a number of community and technical groups. FAME conducts a six-week summer science and math enrichment program with an emphasis on engineering for students in selected local middle and senior high schools. Students in the summer program take an academic enrichment program during the entire school year, in addition to their regular studies. Emphasis is placed on acquiring adequate skills in math and science for entry into engineering colleges and technical disciplines.

Science clubs have been formed and meetings are held twice a month on Saturdays. Teachers and role models assist in conducting hands-on projects such as building a radio, exploring the chemistry of photography, and designing computer logic boards. The program also sponsors cultural events and industrial tours for students.

Texas Alliance for Minorities in Engineering (TAME), founded in 1975, has created a cooperative cross-sectional organization to:

• Analyze the problems causing low percentages of minority engineering students in Texas, and

• Draw together a state-wide information, coordination, and recruitment organization to work with government, industry, secondary schools, community colleges, university departments of engineering, and minority communities.

The Alliance has organized itself into ten geographic areas corresponding to the concentrations of minorities in Texas. Each member alliance is responsible for establishing regional programs to meet local needs.

Committee on Institutional Cooperation (CIC) + Midwest Program for Minorities in Engineering (MPME) is an academic consortium of the Big Ten Universities, the University of Chicago, Illinois Institute of Technology, and University of Notre Dame. The primary objective is to increase the number of qualified and motivated minority high school students by removing many of the academic and aspirational barriers they face. Each member university is engaged in identifying minority secondary school students, motivating them, improving their skills, recruiting, and retaining them in its institution. Although the fourteen participating engineering institutions employ diverse approaches, they seek the same objectives in common.

The Southeastern Consortium for Minorities in Engineering (SECME) is made up of twelve member universities in six southeastern states. Engineering faculty from the member institutions coordinate projects in nearby secondary schools. During the 1978-79 school year, 13,000 minority students participated in project classes in 56 selected school systems. These school systems were invited to design individual plans of implementation, and to submit program proposals to SECME for funding. Much latitude is given in the design of individual plans. Some activities involve selecting talented students to participate in "honors" type programs. Other involvement includes in-service training for teachers and counselors throughout the school system. Funding is provided on a cost-shared basis with each school district contributing to the project. Programs are being implemented through:

• The use of curriculum modules and other supplementary engineering-related materials to enrich and support existing courses in math, science, and language arts in grades nine through twelve;

• The development of engineering guidance programs to increase minority student enrollment in math and science courses, and to enhance these students' awareness of opportunities for minorities in engineering;

• The use of community resources such as local industry, parent groups, and professional organizations.

Mathematics, Engineering, Science, Achievement (MESA), founded in 1970 in Oakland, California, was one of the first efforts that encouraged minority-group students to take the college-preparatory courses they would need to major in mathematics, engineering, and the physical sciences at the university level. Because such fields still attract a

particularly small percentage of blacks, Mexican-Americans, Puerto-Ricans, and American Indians, California high school students from these minority backgrounds are the major target of the MESA program. Through MESA's effort, participating students receive tutoring, and academic, university, and career counseling. They participate in site visits, meetings with role models, and summer enrichment programs in mathematics and science subjects. Scholarships are provided to students achieving academic excellence while still in high school. MESA's goals include: encouraging students from the target minority groups to acquire the educational background they need to major in mathematics, engineering, and the physical sciences at a university; promoting career awareness so that participating students may learn of opportunities in mathematics and science-related professions early enough to prepare for them, and ensuring that secondary schools, universities, industry, and others cooperate with MESA by offering volunteer time and other vital human and fiscal resources.

New regional consortium efforts are emerging to enhance pre-college minority engineering goals and objectives. Two such programs are:

Proposal for Rochester to Interest Students in Science and Math (PRIS²M), an ongoing project for Rochester, New York, was formulated by a special task force of the Industrial Management Council (IMC), which is a long-existing consortium of the hundred top corporations in Rochester. This industry-initiated program is designed to increase the number of students in the city school district who prepare for entry into technology-related careers.

Metropolitan Consortium for Minorities in Engineering (METCON) is an ongoing project in the metropolitan District of Columbia area (including the District of Columbia, Fairfax County, Virginia, Montgomery County, Maryland, and Prince George's County, Maryland).

This regional initiative represents a cooperative effort of local school systems, schools of engineering, community groups, local and federal government, to improve the quality of science and math instruction, as well as career counseling.

LOCAL EFFORTS

Experience over the past five years has shown that the most successful strategies have been those that evolved at the local level. The reason for this appears to be that each local program has been structured to meet the academic and non-academic requirements of the local situation. While the national and regional consortia and organizations can contribute resources and support to carry out local strategies, the ultimate success of the program will depend on local initiatives.

Some examples of local efforts follow.

College of Engineering, Rensselaer Polytechnic Institute, Minority Students Engineering Program, Pre-Engineering Education (RPI) was initiated to give students entering the school additional preparation that improves their chances of success. The preparatory program is conducted for six weeks during the summer by faculty members who are

usually involved in the future course of study. Each participating student is evaluated before the summer program begins (through pre-tests) and given intensive instruction in the basics of chemistry, physics, and mathematics. Minority juniors and seniors serve as tutors, on a one-to-one basis. At the conclusion of the summer program, the faculty evaluates the progress of the students (through post-tests) and makes recommendations about the students' programs for the freshman year.

Stevens Institute of Technology, Stevens Technical Enrichment Program, Pre-College Component (STEP) identifies potential students as early as the ninth grade. The major determinant is usually the student's aptitude and interest in mathematics. Once selected for participation in STEP, the pre-college enrollees enter a Saturday program during the senior high school year and an intensive residential summer program. Both elements are designed to provide these students with career-related training in engineering and science.

Illinois Institute of Technology, Pre-College Program (INROADS/Chicago) recruits talented students with an interest and aptitude in mathematics and science upon completion of the eighth grade. During the subsequent four years of high school, these students are offered supplementary training in mathematics, reading, writing, and the laboratory sciences to prepare them for admission to a local college of engineering. The program consists of a six-week summer session of five-day-a-week classes that are designed to prepare students for the following year's high school curriculum. Subjects include mathematics, reading, writing, study skills, and engineering projects. The students are expected to attend tutorial and enrichment programs during the school year. Engineering-oriented projects, seminars featuring corporate engineers, and field trips are a part of the program's school-year Saturday activities, which the students must also attend.

Parents participate in the program's efforts through the Parents Advisory Council. The program is supported by donations from major corporations and foundations.

Illinois Institute of Technology, Pre-College Program (Early Identification Engineering Program) serves junior high school students who were not involved with the INROADS/Chicago Program. To be accepted into the Early Identification Engineering Program, they must exhibit an aptitude in mathematics and science. Communications skills are also critical. Participation in the program begins in the spring semester of their junior year in high school, with sessions scheduled for three Saturdays. The students become involved in comprehensive projects designed to teach engineering methods.

In the summer following their junior year as pre-engineering students, the participants take an eight-week course in career preparation that includes involvement with other students on project teams, "Survival Tech," which is aimed at developing interpersonal communications skills, mock job interviews, and visits to industrial plants. At the end of the summer session, students are counseled on preparation for the college admission process and on course selections for their senior year of high school.

The students who exhibit outstanding abilities during the summer program may be notified that they are candidates for admission into IIT. Admission depends on meeting the entrance requirements and successful completion of their high school program.

Students can enter IIT's pre-engineering program during their senior year in high school. Students are counseled on career choices in engineering, and if they are accepted for admission to IIT, they receive assistance in planning their college freshman year, and attend Saturday sessions to receive needed reinforcement of their mathematics and science skills. During the summer following high school graduation, students are placed in jobs (through the Pre-Co-op program) to work on significant projects under the supervision of a professional engineer, scientist, or technologist. Students receive salaries during their employment commensurate with their ability.

University of Illinois, Chicago Circle, Greater Chicago Area Program (GCAP) seeks to increase enrollment of qualified students from Chicago-area minority groups in engineering schools to a number consistent with their proportion in the general college-age population. To achieve its goal, the program operates in high schools that have a substantial minority population. Students who exhibit ability are given materials that describe what engineers do, the contributions of minority scientists and engineers, and the expanding opportunities for minority groups in engineering careers. The academic requirements for an engineering career are spelled out to the students.

The program supports workshops for high school teachers in fields pertinent to engineering, and supports high school guidance personnel and teachers in preparing students for engineering careers.

Four universities participate in this effort: the University of Illinois at Chicago Circle; University of Illinois at Urbana-Champaign; Illinois Institute of Technology, and Northwestern University. GCAP works actively to develop contacts with industry to foster financial support and work experience for students planning engineering careers.

Wayne State University, Detroit Area Pre-College Engineering Program (DAPCEP) is a consortium effort whose objective is to increase the number of minorities choosing engineering as a career.

The DAPCEP engineering schools foster in-school and external activities that address the need for strenuous academic preparation. The program, in cooperation with the Detroit Public Schools, is sponsoring the following activities to further its objectives: engineering clubs, industrial experiences, teacher/counselor workshops, and special activities that include tutoring, weekend/summer academic programs at nearby industries and universities, and engineering projects.

The participating universities include: the University of Detroit, University of Michigan-Ann Arbor, University of Michigan-Dearborn, Michigan State University, and Wayne State University.

The above programs represent examples of on-going local programs. There are, of course, others. A comprehensive listing of programs is included in the CME Minority Engineering Resource Directory.